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ABSTRACT

Some of the problems that occur for researchers using the TICCIT computer assisted instructional system are described. The underlying learning strategy of the TICCIT system states that the student rather than the developer is best able to select the order of instructional frames. In order to successfully engage in research with the TICCIT system, students must be placed in a setting where learner control is expected of them and in which they can manifest learner control behavior. Successful TICCIT research also requires that the system be flexible enough to be adapted to a variety of research designs, and that the researcher plan in advance for efficient data reduction. (Author/STS)

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PROBLEMS IN RESEARCHING LEARNER CONTROL

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This paper is obviously not reporting the results of research, or supporting rationale for research; but rather describing some of the problems that occur doing research using the TICCIT CAI system. As most of you know, the TICCIT system was funded under a grant from the National Science Foundation. The Mitre Corporation developed the hardware and software, while Brigham Young University wrote the specifications for the delivery system and was responsible for the Courseware development. I will go no further in describing the TICCIT system except to refer you to a Mitre booklet entitled, "An Overview of the TICCIT Program", Mitre 1976.

TICCIT is currently being utilized at two junior college sites, a home delivery site in New York State for students unable to attend classes, at two U.S. Navy training sites, and at BYU. I have had personnel experience conducting research at the NAS North Island site training S-3A aircrews and at BYU where the system was utilized in mathematics and English instruction for college freshmen.

I intend to discuss the following topics as they relate to doing research on TICCIT, with learner control.

1) Use of ongoing students in learner control research
2) The difficulties in implementing research designed on TICCIT
3) Data reduction

Before we talk about conducting research with the TICCIT system, specifically, I want to digress a bit and cover a most basic underlying assumption, that is doing research with the TICCIT system assumes that the subjects will act the way we

want them to so we can collect data. That is, to be motivated to exert learner control. When we collect data on the TICCIT system we assume the learner control series of hypothesis are true. For example, try these hypotheses:

Hypothesis 1 that learner achievement as defined by errors on the test would be better for the learner-control treatment than for the non-learner-control treatments.

Hypothesis 2 that student efficiency as defined by time to learn would be better for the learner-control treatments than the NONE treatment.

Hypothesis 3 time on test, a measure of student efficiency, learner-control treatments would be better than the NONE treatment.

Hypothesis 4 that student affect, as described by self report of satisfaction, and confidence, as described by student self-rating of projected test score, would be better for the learner-control treatments than the non-LC treatments.

POINT 1

The basic underlying learning strategy built into the TICCIT courseware is that the student can pick the next best instructional frame, not the instructional developer, alas..... This raises a problem, the research must be conducted with the subject in a setting where he will optimize for learner control.

Our initial study on Learner-Controlled Instructional Strategies (Walker, Axtell, Warner, and Merrill, 1977), testing the before mentioned hypotheses, utilized random access slide projectors, Kodak RA-960, and the Lehi-Valley Timing Device to

collect data on student frame latencies. One observer was required for each subject and the subject was forced to interact with the observer for frame selection. The presence of the observer may have biased the subject. The student may not have exercised learner control because he wanted to excell in the material. An example of this problem is that many subjects attempted to hide their practice problem results from the observer in order not to allow the observer to see their progress. This was observed when they were doing poorly or were uncertain of their progress. The presence of the observer may have interacted with the students' attempts to learn the material.

The student population was drawn from a beginning Psychology course. Most of the students were female, 60 out of 75, and many expressed to the observers that they never did well in mathematics, when they were told that the subject matter was logarithms. When a student attempted a practice problem, they were given immediate correct answer feedback. It was observed that many students continued to do all the practice items when they in fact had control of the number that they could do in two of the treatments. When questioned by this observer why they continued to do all the practice items even though they had already sensed that they were able to master the material, they replied that the correct answer feedback and the instruction was giving them confidence that they never before had in a mathematics subject. They may have not exhibited learner control merely due to their desire to maximize positive feedback.

A further problem is that the subjects had committed two to three hours of their time to spend on the experiment. In retrospect,

this might have biased the subjects to look at as many frames as possible since they were under no constraint to maximize their efficiency.

In order to overcome the problems encountered in the first experiment the TICCIT CAI system was utilized as a delivery system for further studies. This tended to eliminate the problems of observer/student interaction. The students were able to call up frames without the interaction of the observers. In addition, the students were selected from an on-going Mathematics class. Part of their class requirements was mastery of the experimental material (logarithms). A pilot study conducted in May 1977 demonstrated that subjects from an on-going class, if given the strategy options, did exhibit learner-control strategies, thus correcting some of the before mentioned problem. They were not alerted to a time duration of the study and therefore were not biased as to a prescribed amount of time for completion.

By intervening in a class setting, using the TICCIT CAI system without observers, and not alerting the students as to the expected duration of the study, created an environment which allowed for optimization for the collection of data for learner-controlled variables.

The North Island and subsequent BYU research had vastly different results since we intervened in on-going instruction and by so doing were able to produce results that indicated that we had successfully produced a setting where learner control was exerted by the students.

In summary, my point is that in order to do research with a system (TICCIT) that assumes learner control, students must be

placed in a setting where learner control is expected of them and they can manifest learner control behavior.

I will now discuss conducting research on two levels that I chose to call micro and macro.

First, problems conducting research on the micro level: that is, forming hypotheses, adapting the system to deliver them, then analyzing the data, sorting, and testing for significance.

The macro level which I will later discuss involves looking at a large number of students over a long period of time, say a term, then analyzing how they use the system.

At the micro level first one must form hypotheses and generate treatments. An example of this is a study Ron Axtell, Dave Merrill, and I conducted during the summer of 1977. We devised four treatments, (the overlay).

In the NONE treatment, the students were given a rule display, followed by example displays, followed by practice displays. They had no selection over the order or number of instances selected.

The PPF (Primary Presentation Form) treatment allowed the students to select the rules, examples, and practice frames in any order but they did not have control of the number of instances they could select. They had to look at all the frames that were available.

The MORE treatment allowed the S to select the number of instances they chose to see but not the order.

The ALL treatment allowed them to exercise both sequence and instance number control.

In order to allow us to set up the TICCIT system, Ms. Kathie Fletcher had to rig the system in the following manner:

The NONE treatment was implemented by presenting all rules, examples, and practice items under the PRACTICE button.

The MORE and PPF treatments were implemented by presenting the RULE under the help function and separating the examples and practice items into different difficulty levels.

The ALL treatment modification was the same as the PPF treatment with the addition of more segments of examples and practice items.

POINT 2

My second point is this: At present a field site must be careful in selecting instructional treatments, in that it is difficult to set up the system in order to collect data. Changing the inherent "inbed" learning strategies is a difficult problem with the current software package in the TICCIT system.

I would hope in the future that the ability to modify the TICCIT learning strategies would be forthcoming, allowing greater flexibility in selecting treatments.

A researcher could it is envisioned be able with some simple mechanism select for each student which of the learner control keys are operational. For example, for some students might have the rule key, but not rule help and so on.

POINT 3

My third point is that data reduction is a problem. Currently the TICCIT computer must be used to sort responses for each student. This must be done when the system is not up for student use and interferes with other time demands on

the system. A 24 hour day must be spread among student use, graphics entry, hardware maintenance, authoring, software debugging, etc. Data reduction for research takes low priority with an operational system.

Once, however, the student responses have been sorted, you are given an overwhelming amount of data. An example of this data per-student is: (I will discuss what is on Slide 2).

Insert Figure 2 about here

At first we attempted to reduce this data manually which for 120 students took about three weeks. However, Dr. Monty Shelly at BYU assisted us in developing a Fortran program that allowed us to analyze the data on an IBM 360 computer and this greatly facilitated data reduction. I will be happy to discuss this program after the talk. The point here is: (1) You must expect to collect a lot of data that is vastly more than you usually collect in an experimental setting, and (2) You must plan how to reduce it and decide how to use it.

The Shelly Fortran program prints out the data on IBM cards that are punched by the IBM 360, thus allowing us to then punch on to them selected student data; e.g., ACT score, sex, age, etc. Statistical analysis is then done on the IBM 360 or DEC 10 computer system using SPSS or rummage.

If we take the macro approach analyzing all the student inputs for a long period of time, say a term, the sorting student data becomes a real problem. The current TICCIT software

just does not facilitate this work. The computer must look for each student each day and sort his responses.

The log tapes cover only one instructional day, thus the data reduction in the macro approach that must add student responses day to day ties up the computer doing this task, since you may have to do this for 100 days.

One researcher attempting this approach at BYU is finding that data reduction is monumental in the macro approach.

There is hope, however; at BYU a program is being developed to do the sorting on a large computer, DEC 10, thus freeing up the TICCIT computer.

Once the data is sorted, it can, however, be reduced by the IBM 360 already described. To make sense of this data, however, is another topic that I won't attempt to discuss at this time but enough to say that the researcher is almost flooded with data.

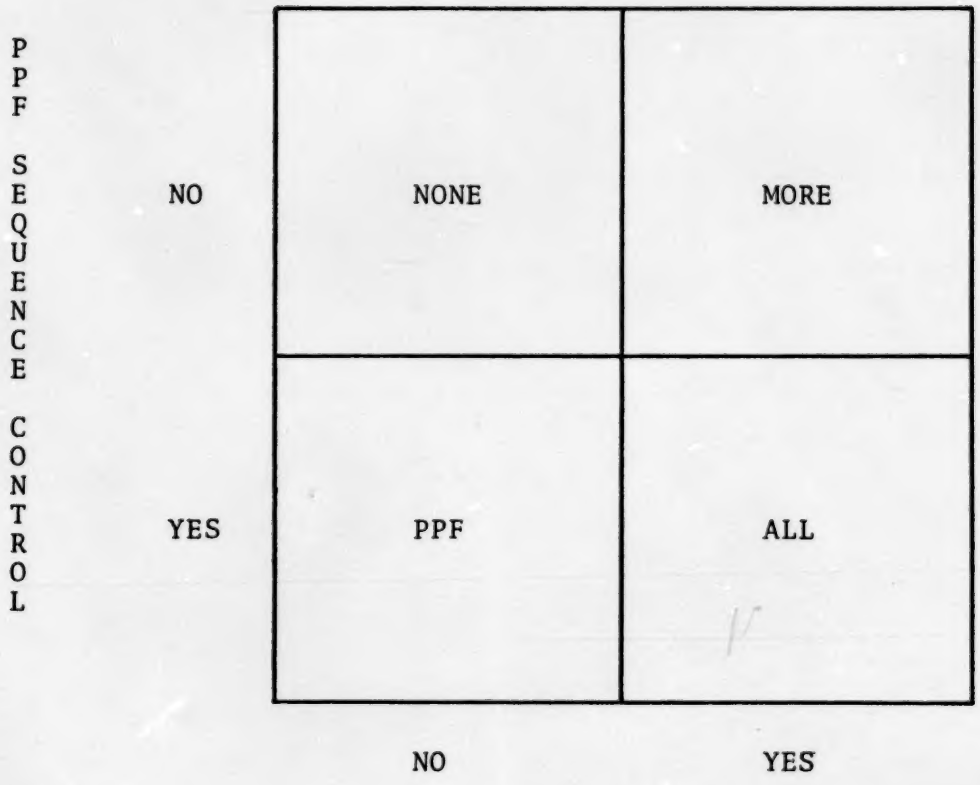
In summary, TICCIT is a research tool that is allowing us to collect vast amounts of data that are helping to push forward our knowledge of instructional science. We must carefully prepare the data collection, treatment generation and data reduction, however, if we are going to optimize the use of this valuable tool.

Learner control research can be done if we:

1. Place the learners in a setting where they will be optimal for learner control research.

2. Adapt the system for the research design we chose.

3. Plan for the data reduction.



Slide 1. Factorial Arrangements of the Treatments

Name	Date	Sample
Date	xx/xx/xx	05/12/77
Course	xxxxx	2300
Unit	xx	16
Lesson	xx	4
Segment	xx	5
Function	xx	Q P = Practice F = Feedback E = Example etc.
Part #	xx	1
Page #	xx	1
Student #	xxxxxxxxx	0000049154
Time of day	xx:xx:xx	09:19:19
Latency	xxxx	18 (sec.)
Terminal ID	xx	12
Response Type	xx	Help (Learner Control Functions)
Flags	xx	Right or Wrong (Practice or test item)
Difficulty level	x	Easy, Medium, Hard
Item #	x	1, 2, etc.

Slide 2. TICCIT log tape recording of student data